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EFFECTS OF LONG-CONTINUED FALSE FEEDING ON THE PROCESSES OF EXHAUSTION AND RECOVERY IN THE PAROTID SALIVARY GLAND

Fiziologiya nervnykh protsessov [Physiology of Nerve Processes], 1955, Kiev, Pages 415-419

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In his paper "The Nutritive Center" I. P. Pavlov wrote: "Just as the respiratory center regulates the constant quantity of oxygen in the organism, the nutritive center regulates the delivery of liquid and solid substances to the organism. Consequently, the food center nerves are stimulated by the chemical composition of the blood of a hungry animal; this internal automatic stimulus exists, to begin with, in latent form, but then begins to reveal itself in the animal's movements in the direction of food, in salivation, etc." Speaking of the inhibition of the food center, I. P. Pavlov put forth this idea: "The meaning is clear: if food has entered the stomach, the nutritive center must cease working temporarily until the food thus introduced has been digested."

These statements have obtained experimental confirmation in the works of I. P. Razenkov, who demonstrated that "when the blood contains a high quantity of chemical stimuli one may observe a reduction in the excitability of the 'nutritive nerve center,' while when this content is low, an elevation may be seen."

Studying the interrelation between the processes of exhaustion and recovery in the salivary glands, G. V. Fol'bort and associates found that total nitrogen in the saliva shows a marked decline within one to 1 1/2 hours after the beginning of the experiment, and sometimes sooner, under the influence of long-term

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activity. This decline in total nitrogen in parotid saliva has been regarded as an exhaustion of the functional possibilities of the salivary gland under the effect of long-term secretion. The process of recovery, however, depends upon the degree of exhaustion: the more profound the process of exhaustion, the longer the process of recovery. E. M. Gofman has shown that after a 3-day process of exhaustion, the function of the gland is restored after 9 to 12 days, while after a single day of exhaustion, [illegible] occurs in 6 to 7 days. The question has repeatedly arisen as to how satiation of the animal is reflected in the course of exhaustion and recovery of the salivary gland. We concluded that it was possible to solve this problem by studying the course of exhaustion and recovery in the salivary gland of gastroesophagotomized animals, in which the possibility of satiation did not exist.

In the present study we undertook to follow the effect of long-term false feeding on the processes of exhaustion and recovery of the parotid salivary gland. We took as our standard of functional capacity the change in the amount of total nitrogen, and as index of change in the amount of protein the main function of the saliva from this gland.

Total nitrogen in the saliva was determined by Kjeldahl's micromethod, as modified by Bang.

The experiments were set up as follows. The normal amount of total nitrogen in the saliva of dogs with parotid and gastric fistulas was determined. This was done by collecting three 5-to-7-minute saliva specimens at 5-minute intervals. The stimulus consisted of one-gram rusks given to the dogs at 15-second intervals.

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When normal total nitrogen in the saliva had been determined, an experiment in long-term secretion was set up. Toward this end, the dog was fed constantly until food was refused. Now, too, saliva was taken every 5 to 7 minutes. After the experiment, we followed the course of recovery each day on the same basis on which the normal level had been determined.

Two to 3 weeks after recovery of the function of the salivary gland the dogs were subjected to esophagotomy, so that subsequently the same experiments were performed on gastroesophagotomized animals as had been performed prior to esophagotomy.

In the present work we present data based on experiments with a single dog, which were typical of the 4 other dogs (Figure 1).

Figure 1 shows the course of change in the total nitrogen within parotid saliva during long-term secretion (dog Dzhek). In this experiment the dog continued eating for an hour and a half.

It is clear from the curve in Figure 1 that the total nitrogen in the parotid saliva showed a steady decline during the experiment. After an hour and 15 minutes it proved impossible to find nitrogen in the saliva, so that we had thus obtained the picture that had been noted by many researchers in the first experiment with exhausted salivary glands.

After esophagotomy, an experiment was set up with this dog 30 October 1951 involving long-term secretion of the parotid salivary gland under the influence of long-term false feeding (Figure 2).

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The curve in Figure 2 presents the course of change in the amount of total nitrogen in parotid saliva under the influence of long-term false feeding. The experiment lasted for an hour and 45 minutes. Despite the longer activity of the salivary gland, the amount of total nitrogen in the saliva declined by 28%, i.e., from 52 mg% in the first specimen to 38 mg% in the last.

Judging by the course of the decline in total nitrogen in parotid saliva during the long period of false feeding, it may be stated that there was no profound exhaustion of the function of the salivary gland. We observed a similar picture in all animals in our experiments with long-term false feeding. This slight decline in total nitrogen under normal conditions of long-continued secretion had not been noted by any previous investigator. The conclusion might be drawn that the exhaustion of the parotid salivary gland under long-term false feeding is insignificant. An entirely different conclusion is suggested, however, by the course of the process of recovery subsequent to the experiment with long-term false feeding.

We adduce 2 diagrams of the course of recovery of function by the salivary gland prior, and subsequent, to esophagotomy (Figures 3 and 4).

The diagram in Figure 3 reflects the course of recovery subsequent to an experiment with long-term secretion, prior to esophagotomy. The total nitrogen is seen to rise each day, as does the amount in each successive specimen of saliva. During the first day of recovery, the total nitrogen in the first saliva specimen was 22 mg%. Thereafter, the amount increased. After the phase of

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recovery there appeared, on the sixth or seventh day, firm recovery in the total nitrogen. A similar picture was observed in the majority of experiments during recovery of parotid function by E. M. Gofman, M. P. Samotaya, et al.

It would appear that after the inconsequential exhaustion of the gland observed in the experiment with long-term false feeding, recovery should take place certainly by the second or third day.

The diagram in Figure 4 shows that on the day after the experiment with long-continued false feeding, the dog refused completely to eat rusks, while 2 days after the experiment with long-term secretion, the first saliva specimen contained 20 mg% less total nitrogen than in the last specimen during the experiment on exhaustion. In the subsequent specimens the total nitrogen increased. Recovery proceeds in the same fashion as after the experiment with long-term secretion prior to esophagotomy, passing through a stage of recoverability. Recovery occurs 6 to 7 days after the experiment.

We believe the slow course of recovery after the experiment with long-term false feeding, in which the total nitrogen shows an inconsequential decline, testifies to the profound exhaustion of the gland. Thus it is clear that functional ability must be judged not only by the process of exhaustion, but by the manner in which the process of recovery proceeds.

Analysis of this data has led us to the following hypothesis. High excitation of the nutritive centers arises during long-term false feeding under the effect of influences from the receptors of

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the oral cavity, the muscles of mastication, and the empty stomach. A constant stream of impulses flows from these sources to the salivary gland, causing it to operate at an elevated rate.

The constant arrival of strong impulses to the gland leads to profound exhaustion, which is manifested only after a day or two, in the form of a reduced amount of total nitrogen in the saliva. This profound exhaustion results in long-term, slow recovery.

Under normal conditions of feeding the exhaustion is not so profound, although the total nitrogen declines more considerably. The processes of recovery proceed somewhat more rapidly. This may be explained by the fact that during long-term normal feeding the stomach fills with food, and under the influence of the excitation of receptors or filling of the stomach there occurs an inhibition of the central nervous system. Consequently, functioning of the gland ceases, as it no longer receives impulses from the central nervous system.

Thus, our data confirm G. V. Fol'bort's proposition to the effect that the deeper the process of exhaustion, the longer the process of recovery of functional capabilities. They also sustain the data of Pavlov and Razenkov to the effect that satiation of an animal leads to inhibition of the nutritive center. This affects the salivary gland in the sense that exhaustion of its functional capabilities in normal feeding is less profound, and recovery sets in much more quickly, than in false feeding.

Consequently, it may be stated that the depth of exhaustion of the salivary gland depends upon the state of the nutritive centers. However, the state of the nutritive centers depends upon whether the stomach is empty or full.

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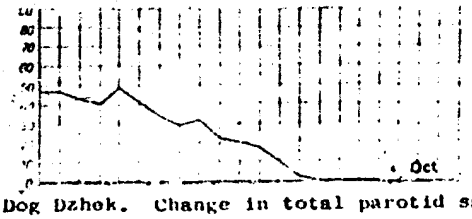

Figure 1. Dog Dzhek. Change in total parotid saliva nitrogen during long-term secretion.

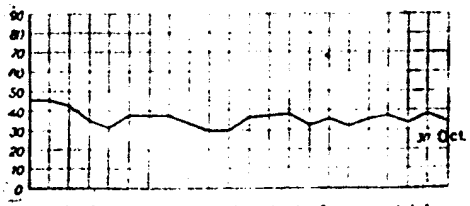

Figure 2. Dog Dzhek. Change in total parotid saliva nitrogen as affected by long-term false feeding.

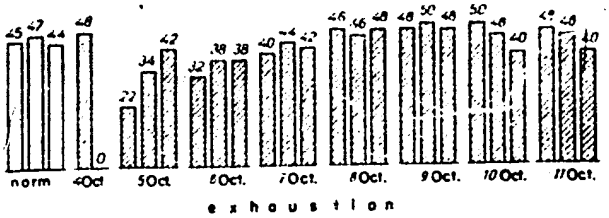

Figure 3. Dog Dzhek prior to esophagotomy. Recovery of total parotid saliva nitrogen subsequent to long-term secretion.

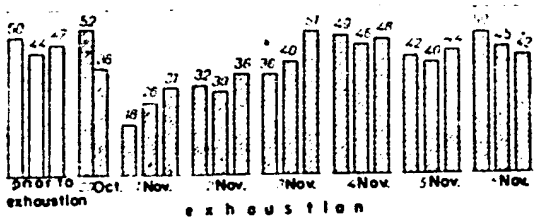

Figure 4. Dog Dzhek subsequent to esophagotomy. Recovery of total nitrogen in parotid saliva subsequent to long-term secretion.

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